Dr. Nnakwo, Fidelis Okonkwo, November, 2022

EFFECT OF QUADRATIC EQUATION X-FLATS ON SENIOR SECONDARY SCHOOL STUDENTS' ACADEMIC ACHIEVEMENT IN ALGEBRA

IN ENUGU STATE

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Abstract

The purpose of this study was to investigate the effect of quadratic equation X-flats (QEXF) on senior secondary school students' academic achievement in algebra. Two research questions and Two hypotheses guided the study. The design used for the study was quasi-experimental non-equivalent control group design. The population for the study was 5,386 Senior Secondary school one (SS1) Students in the 31 government secondary schools in Enugu Education Zone. A sample size of 316 SSI mathematics students drawn through random sampling techniques from four single sex schools was used for the study. Each of the schools were randomly assigned to experimental and control groups. Two intact classes in each sampled schools were used. The intact classes were taught quadratic equations/expressions using X-Flats. The instrument for the study was validated by three experts and used for the study. The instrument used is quadratic equation achievement test. The reliability coefficient was 0.79 using KR-20. The research questions were answered using mean and standard deviation scores. The hypotheses were tested at 0.05 level of significance using analysis of covariance (ANCOVA). The results showed that the quadratic equation X-flats (QEXF) improved students' achievement in algebra significantly. The study also revealed that there is no significant difference between male and female students' academic achievement in algebra. The study recommended, among others, that since the QEXF was found to be facilitative instrument approach for enhancing achievement in algebra, teachers should adopt it as instructional approach in teaching algebra.

Key words: Quadratic Equation X-Flats, Achievement and Gender

Introduction

Mathematics education is the practice of teaching and learning of mathematics as well as a field of scholarly research and practice (Uka, Iji and Ekwueme 2012, in Irene and Nwigboji 2017). According to Odili (1990) in Irene and Nwigboji (2017), mathematics education is the process of shifting from methods of teaching which has to do with acquisition of computational skills to methods of learning mathematics, which enhances the understanding of mathematics and its application in order field of study and real life situation. Onoh (2005) in Okafor (2015) opined

that no nation can advance economically, scientifically and technologically without laying emphasis on the teaching and the development of mathematics education.

Therefore, students required the ability to use technology effectively and acquire skills for processing information. This is the reason mathematics curriculum today aims at preparing them with essential mathematical knowledge and skills of reasoning, problem-solving, communication, the ability and incentive to learn on their own. Regrettably, research evidences such as Ohanusi (2011), Derbuck and Kpakor (2012), Oluremi and Ajao (2012) as well as Kuntu and Pedro (2013) cited in Nneji and Alio (2017) submitted that this all important subject is dreaded, hated, feared and massively failed by students, especially at secondary school level. Omoniyi (2015) suggested that the study of mathematics was established in schools in order to produce competent person who are skilful in a mathematical knowledge in solving everyday life problem. Mathematics education is a precursor of scientific discoveries and inventions (Salmon 2005, in Nwoke 2017). Hence, mathematics Education needs serious attention in the aspect of instructional approach in teaching and learning of mathematics. This study will investigate one of the instructional approaches, quadratic equation x-flats.

Quadratic Equation Box was named, designed and constructed by Obodo (2004). The quadratic equation box is made up of wood. According to Obodo, the quadratic equation box is 25cm long, 21cm wide and 19cm high. It is provided with a lock and key to preserve the content. The contents are three types of flats. X-square flats, x-flats and unit flats. The x-flats are instructional materials that can enable an individual or a group to lay out ideas on quadratic equations and expressions in plane rectangular shapes. It is a concept of using rectangular plane to enhance meaningfully learning and develop meta-cognitive strategies in Algebra. This instructional materials (x-flats, x-squares and unit square) is hoped to be capable of resolving the cognitive conflicts introduced in the minds of the learners, so that they can develop interest and achieve more. Robert (2007) supported this assertion when he stated that for many students, abstract algebraic concepts are more easily grasped with concrete representations of a concept in Algebra.

According to Iji, Okoronkwo and Anyor (2017), Algebra is the branch of mathematics that deals with general statements of relations, utilizing letters and other symbols to represent specific set of numbers, values and vector among others, in the description of such relations. Nneji and

Alio (2017), opined that secondary education algebra mainly introduces the concepts of variables, representing numbers and these variables are manipulated using the rules of operations that apply to numbers. Nneji and Alio further said that algebra does not only deal with properties of numbers but also reveals how those properties can be applied in solving day to day practical problems. Nneji and Alio continued to say that good skills and competences in algebra is a great asset to any secondary school student because it is a tool for developing critical and logical thinking that can facilitate the learning of other branches of mathematics and even other science subjects. Hence, it is worrisome that Ohanusi (2011) and Ohuremi and Ajuo (2012) in Nneji and Alio (2017) among other mathematics education researchers reported that secondary school students tend to fear and hate algebraic topics to the extent that they avoid algebraic questions in both internal and external examination. This is therefore, affect the student's achievement in mathematics. WAEC chief Examiner's report of 2008 to 2014 cited in Egbe (2017) stated that the poor achievement of students in mathematics is traceable to their poor understanding of the algebra content. However, many research reports show that the achievement of students in mathematics at all levels of education system is poor.

Hence, there is need for a search for more appropriate approaches to teaching and learning of algebra. According to Akande (2017), students cannot achieve excellent results except the best method of teaching and learning of mathematics are discovered and used appropriately. Akande further said that the abstract nature of mathematics as a subject scares many students. Musa and Agwuagah (2006) cited in Akande (2017) opined that practical activities enable learners to acquire the relative experience that links learning to environment on their own through the process of thinking, thereby causing positive changes in their activities. According to Nwoke (2017), the persistent poor performance of students in mathematics has variously been blamed on teacher's use of ineffective instructional approaches. Onyeneto and Onyibor (2000) cited in Nwoke (2017) stated that poor academic achievement in the schools queries the method of instructional strategy and therefore called for an indepth investigation with a view of establishing the relationship between instructional methods and students achievement.

However, a pertinent question may arise as to know whether quadratic equation X-Flats may have differential effect on Male and Female students in mathematics. This is because some research results show that there are gender imbalance in mathematics achievement in secondary

schools. Abigail (2015), showed that there is disparity in cognitive achievement of male and female students with male having higher achievement series. Nnamani and oyibe (2016),showed that girls do better at all level than boys in achievement. While Eneze and Ebuoh (2017), showed that both male and female students achieve equally poorly at ordinary pass level in each of the five years studied. According to Amadi (2015), the problem of poor achievement in mathematics in senior secondary schools is more with female students than with male. Ogunkule (2007), cited in Nnakwo (2019),suggested that though there exist gender difference in favour of male students' achievement when taught with constructivist strategy, new approach to mathematics teaching may eradicate the imbalance. It is on this suggestion that the researcher investigated the difference in achievement of male and female students when taught algebra, especially quadratic equations/expressions with quadratic equation x-flats. Egbe (2017) stated that many approaches have been used in the past for teaching algebra. These include problem solving, discovery method, concept development and laboratory method. Egbe further said that in spite of all these instructional approaches, senior secondary school students' achievement in algebra is still low.

It is based on this poor achievement and gender disparity in the area of algebra that made the researcher to investigate quadratic equation x-flats approach in teaching algebra. it is against this background that the researcher sought to find out, if quadratic equation x-flats will enhance the achievement of students in algebra and eradicate gender difference in students' achievement in algebra.

Purpose of the Study

The main purpose of this study was to investigate the effect of quadratic equation x-flats approach on secondary school students' academic achievement. Specifically, to determine the effect of quadratic equation x-flats on:

1. students' achievement in quadratic equations and expressions.
2. Male and female students achievement in quadratic equations and expressions

Research Questions

The following research questions guided the study

1. What are the mean achievement scores with standard deviations of students taught quadratic equations and expression s using the quadratic equation x-flats approach

(experimental group) and those taught with expository method (control group) as measured by OEAT?

2. What are the mean achievement scores with standard deviations of male and female students taught quadratic equations and expressions using quadratic equation x-flats approach (experimental group) and those taught using expository method (control group) as measured by QEAT?.

Hypotheses

The following hypotheses was formulated and tested at 0.05 level of significant.

1. There is no significant difference between the mean achievement scores of student taught quadratic equation and expression using quadratic equation x-flats approach (experimental group) and those taught with expository approach (control group) as measured by QEAT.

2. There is no significant difference between the mean achievement scores of male and female students taught quadratic equations and expressions using quadratic equation x-flats approach(experimental group) and those taught with expository method (control group) as measured by QEAT.

Methodology

The research is a quasi-experimental study. The study was carried out in Enugu Education zone, Enugu State. The population for the study consisted of all the 5, 386 senior secondary one (SSI) students in the thirty-one (31) government schools under Enugu Education zone, Enugu State. The sample of this study was 316 students from four randomly sampled intact classes of SSI students draw from two boy's secondary schools and two girls secondary schools purposively sampled in Enugu Education Zone. The sample size was 162 students in treatment group and 154 in control group. The sample comprised 80 males and 82 female students in the experimental group and 70 males and 84 females in the control group. The experimental group was exposed to learning of quadratic equation X-flats while control group was exposed to expository teaching method in the learning of quadratic equations and expressions. The instrument used for data collection was quadratic Equation Achievement test (QEAT). The QEAT consisted of 40 multiple choice-test items with four options A, B, C, D, developed by the researcher. One option was correct answer while three were wrong answers. The test blue print used in constructing the instrument was developed by the researcher based on the relative emphasis on each of the sub-topics in SSI

mathematics curriculum. The quadratic Equation Achievement test (QEAT) was subjected to face validation by three experts (two from mathematic Education and one from measurement and Evaluation). The method of data analysis was mean with standard deviation for answering the research question and ANCOVA was used for testing the research hypothesis at 0.05 level of significance.

Results

Research question 1

What are the mean achievement scores with standard deviations of students taught quadratic equations and expressions using quadratic equation x-flats approach (experimental group) and those taught with expository method (control group) and those taught with expository method (control group) as measured by QEAT?

Table 1: mean achievement scores with standard deviation of Experimental and control groups.

Group	N	Pre-test		Post-test		Min score point	Max. score points
Experimental	162	6.94	3.01	25.87	8.92	0	40
Control	154	8.76	4.67	14.29	9.46	0	40

From the table 1 above, the pre-test score for experimental and control groups were 6.94 and 8.76 respectively with corresponding standard deviations of 3.01 and 4.67 respectively. The post-test mean scores were 25.87 and 14.29 for experimental and control groups respectively with corresponding standard deviation of 8.92 and 9.46.

Research question 2

What are the mean achievement scores with standard deviations of male and female students taught quadratic equations and expressions using quadratic equation x-flats approach (experimental group) and those taught using expository method (control group) as measured by QEAT?

Dr. Nnakwo, Fidelis Okonkwo, November, 2022

Table 2: Mean Achievement Scores with Standard Deviations of experimental and control groups due to Gender.

Group	n	Pre-test		Post-test		Min. score		Max. score	
		Male	Female	Male	Female				
		Mean	SD	Mean	SD	Mean	SD	Mean	SD
Experimental	162	5.68	2.96	8.20	3.01	8.08	25.73	9.82	0.40
Control	154	9.21	4.49	5.30	14.11	10.28	14.49	9.19	0.40

Where n=Sample Size per group

From the table above, the mean pre-achievement test scores of male and female students in experimental and control groups ranged from 5.68 to 9.21.The post- achievement test score of male and female students in both groups ranged from 14.11 to 26.01.These scores were obtained out of a maximum score of 40.

Hypothesis 1.

There is no significant difference between the mean achievement scores of students taught quadratic equations and expressions using quadratic equation x-flats (experimental group) and those taught with expository method (control group) as measured by QEAT.

Hypothesis 2.

There is no significant difference between the mean achievement scores of male and females taught quadratic equations and expressions using quadratic equation x-flats approach (experimental group) and those taught with expository method (control group) as measured by QEAT.

Table 2: below shows the results for hypothesis 1 and 2 on achievement.

Source	Type III sum of square	Df	Mean square	F	Sig	Dec
Corrected model	3.459	3	1.153	20.964	0.000	
Intercept	212.545	1	212.545	3864.455	0.000	
Method	1.158	1	1.158	21.055	0.000	S
Gender	0.049	1	0.049	0.891	0.400	Ns
Method and gender	0.038	1	0.038	0.691	0.406	Ns
Error	17.050 310	0.055				

Total   346.038   314

Corrected total   33.282 315

From the table 3, above, the F-calculated value of 21.055 for method was significant at 0.000 significant levels which are less than the 0.05 level of significance set for this study. Hence, the researcher rejects the null hypothesis of no significant difference. This means that there is a significant difference between means achievement scores of students taught quadratic equations/expressions using quadratic equation x-flats (experimental group) and those taught with expository approach (control group) as measured by QEAT. For gender, the F-calculated value of 0.891 was found significant at 0.400 significant levels which are higher than 0.05 level of significant set for this research. Therefore, there is no significant difference between mean achievement scores of male and female students.

Discussion of the findings

Results from table 1,2 & 3 showed that experimental group obtained higher mean scores than the control group in the post- QEAT. The findings showed that students taught with quadratic equation x-flats (QEXF) achieved significantly higher/better in quadratic Equation Achievement Test (QEAT) than those exposed to Expository method. This means that quadratic equation x-flats strategy was better than expository method in students' achievement in algebra. This may be because QEXF gave room for students active participation during the teaching and learning of quadratic equations and expressions. This result was in agreement with the findings of Nwabueze (2009), Iji and Uka (2014) and Akande (2017) who found in their separate studies that treatment was more effective than the expository method in enhancing student's achievement. The study also revealed that male students had slightly higher mean achievement scores than female counterparts. The study showed that the difference was not significant. This means that gender was not a barrier in students' achievement in algebra. This could be associated with the separation of boys' schools from girls' schools during the treatment. The findings of the study in respect of gender were not in agreement with the findings of Abigail (2015),Ozomadu (2015),Alio and Anibueze (2017) who found out in their difference studies that significance difference existed with respect to gender in students' achievement. Although this is in agreement with the findings of Salami and popoola (2017) and Nwoke (2017), who found out in their individual studies that no significant difference existed with respect to gender in students' achievement.

Recommendations

Based on the findings of the study, the following recommendations were made:

1. Curriculum planners should give greater emphasis on QEXF in the curriculum for the teachers so as to popularize its use among the teachers in teaching and learning algebra.

2. Authors of mathematics textbooks should develop books which reflect instructional strategies like QEXF with teachers guide.

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